09-09-04

206,506

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Reid	Examiner:	
Application Number:	10/825,760	Group Art Unit:	
Filing Date:	April 16, 2004		
Title:	CAM SYSTEMS		

STATEMENT OF FILING BY EXPRESS MAIL 37 C.F.R. SECTION 1.10
This correspondence is being deposited with the United States Postal Service on September 7, 2004 in an envelope as "Express Mail Post Office to Addressee" Mail Label Number ET 537 591 097 US addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

CLAIM OF PRIORITY

The applicant hereby claims priority under 35 U.S.C. § 119 to the following patent application:

Country	Application Number	Filing Date
New Zealand	525,313	April 16, 2003

A certified copy of the above-identified New Zealand patent application is submitted herewith.

Respectfully submitted,

Date: September 7, 2004

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Ministry of Economic Development
Manatū Ōhanga
Intellectual Property Office of New Zealand

CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 11 April 2003 with an application for Letters Patent number 525313 made by Peter John Kenneth Reid.

I further certify that the Provisional Specification has since been post-dated to 16 April 2004 under Section 12(3) of the Patents Act 1953.

Dated 24 May 2004.

Neville Harris
Commissioner of Patents, Trade Marks and Designs

COMMISSIONER OF PATENTS, TRADEMARKS & DESIGNS
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525313

POST-DATED UNDER SECT. 12(3)
TO 16-4-2003

PATENTS FORM NO. 4

Appln Fee: $50.00
Pipers Central Ref: 12-2309NZ

PATENTS ACT 1953

PROVISIONAL SPECIFICATION

IMPROVEMENTS IN AND RELATING TO CAM SYSTEMS

I Peter John Kenneth Reid, a New Zealand Citizen of 70 Riri Street, Rotorua, New Zealand

do hereby declare this invention to be described in the following statement:

IMPROVEMENTS IN AND RELATING TO CAM SYSTEMS

Technical Field

The present invention is directed to improvements in and relating to cam systems.

In particular, the invention relates to aspects of the manufacture and operation of an improved cam system incorporating features to enable the speed of the cam to be varyingly adjusted in several ways.

It is envisaged the adjustable cam will be used with traveling irrigators. However, it should be appreciated that this invention may have applications outside this field.

Background Art

The cam is one of the most basic means of timing or activating interrelated motions. A cam is a mechanical component on which a particular profile has been machined. The profile of the cam effects a follower to move in a particular way. More particularly, a shaft (typically associated with the cam) is rotatable. As the shaft rotates, so does the cam with which it is associated. As the cam rotates a follower effects a preferred movement relevant to the mechanical requirement.

While the present invention has a number of potentially realisable applications, it is in relation to problems associated with existing cam systems used with traveling irrigators that the present invention was developed. More specifically, it was with the problems associated with the lack of ability to vary the cam speed within readily available variable systems, or within existing fixed cam structures in mind, that the present invention was developed.

Travelling irrigators are commonly used on farms for transferring the substantially liquid wastes from a dairy (milking) shed over neighbouring paddocks in a manner that directly

returns raw nutrients to the land. In other applications, any suitably fluid substance may be sprayed, or aerated, as required for the particular situation.

The cam associated with a traveling irrigator is typically in the form of a plate cam. In such machinery the cam system provides power during revolution of the cam plate as the irrigation boom revolves. The rotational movement of the cam plate is translated through the follower to effect the winding in of the wire rope of the irrigator. In such applications the cam plate is fixed to a preferable size and shape. Such fixed structural features operate against the cam dimensions being adjustable and thus limit adjustability of the translational motion effected through the follower and hence restricts any variability of the speed of the preferred operation.

There is a range of fixed cam systems available in the prior art. Adjustable cam systems are also known, (such as use of time adjustable cam gears to enable an engine's cam timing to match its tuning state). However, existing adjustable speed cams are not preferably transferable to the operation of a traveling irrigator.

Having a simple variable speed cam system for use with traveling irrigators would benefit the operation of the irrigation process by allowing for either a speeding up of the operation or slowing it down, depending on the size of the area being irrigated and/or the quantity of fluid being delivered by the irrigator.

However, at times it is useful to have the standard cam plate to effect the standard operation of the machine.

It would be useful therefore, to have a cam system that:

a) Could have the benefits of being adapted to vary the cam speed to increase or slow the speed of the particular operation when required; yet

b) Could operate at a standard fixed speed relevant to the machine and requirements of the situation in certain circumstances; and

c) Could be easily adjusted requiring minimum time and physical requirements on the part of the user; and

d) Offered a range of adjustments to effect incremental speed adjustment.

It would therefore be advantageous to have an invention that offered at least some if not all of the advantages of the above proposed system.

It is therefore an object of the present invention to consider the above problems and provide at least one solution which addresses a plurality of these problems.

Ideally the present invention will also provide a cam system which allows for the substantially trouble free variability of cam speed.

Ideally the cam system is suitable for use or is suitable to being adapted for use in situations where fixed speed cams are currently employed.

It is therefore a further object of the present invention to at least provide the public with a useful choice or alternative system.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only. It should be appreciated that variations to the described embodiments are possible and would fall within the scope of the present invention.

Disclosure of Invention

Whilst the present invention has particular reference to the features and use of a plate cam, it should be appreciated that the invention may also be applicable to and/or be adapted for use with a face cam, or a cylindrical (drum cam) in particular circumstances.

For the purposes of this specification a plate cam shall mean and include any flat substantially disc shaped structure or plate having a preferred shape (or profile) machined on to the edge of it. The follower is placed in contact with this edge profile and as the cam is rotated with the associated shaft, the edge profile translates into a particular movement of the follower, such as up and down vertical movement, or in and out lateral movement.

Also, for the purposes of this specification, a face cam shall mean and include any substantially disc shaped structure which includes on at least one of its faces a groove machined therein. The follower follows the groove as the cam rotates.

Similarly, a cylindrical or drum cam shall mean and include any cylinder of appropriate dimensions which has a profile machined into it, such that as the cam rotates the profile effects a particular motion with respect to the follower.

As can be appreciated, there are a range of followers available for use with the varying cam structures. These include knife-edge, roller and/or flat followers.

With reference to the present invention, the cam herein described herein has preferable application with either or both a knife edge and roller follower. However, more typically a roller follower is used on travelling irrigators of the kind discussed with relevance to the present description.

According to one aspect of the present invention, there is provided a cam system, said cam system including at least two cam structures, a cam follower capable of following a preferred profile effected by the configuration of at least one of the cam structures, and a substantially central cam shaft, said two cam structures comprising at least one central cam structure and at least one side cam structure, said central cam structure being adapted to receive the cam shaft and further adapted to receive the at least one side cam structure, said side cam structure being adapted to be positionally varied with respect to the central cam structure thereby effecting a change in the profile of the central cam structure alone,

and in turn effecting a change in the overall profile followed by the cam follower during rotation of the cam shaft and the cam structure(s) related thereto, the cam system characterised by the change in profile effected by the positional configuration of the side cam structure effecting variable translational motion to the cam follower and effecting in turn a variation in speed of operation of a preferred movement relevant to a mechanical requirement.

According to another aspect of the present invention, there is provided a method of manufacturing a cam system substantially as described above, said cam system including at least two cam structures, a cam follower capable of following a preferred profile effected by the configuration of at least one of the cam structures, and a substantially central cam shaft, said two cam structures comprising at least one central cam structure and at least one side cam structure, said central cam structure being adapted to receive the cam shaft and further adapted to receive the at least one side cam structure, said side cam structure being adapted to be positionally varied with respect to the central cam structure thereby effecting a change in the profile of the central cam structure alone, and in turn effecting a change in the overall profile followed by the cam follower during rotation of the cam shaft and the cam structure(s) related thereto, the cam system characterised by the change in profile effected by the positional configuration of the side cam structure effecting variable translational motion to the cam follower and effecting in turn a variation in speed of operation of a preferred movement relevant to a mechanical requirement.

According to another aspect of the present invention, there is provided a method of varying the speed of operation of a cam system substantially as described above, said cam system including at least two cam structures, a cam follower capable of following a preferred profile effected by the configuration of at least one of the cam structures, and a substantially central cam shaft, said two cam structures comprising at least one central cam structure and at least one side cam structure, said central cam structure being adapted to receive the cam shaft and further adapted to receive the at least one side cam structure, said side cam structure being adapted to be positionally varied with respect to the central

cam structure thereby effecting a change in the profile of the central cam structure alone, and in turn effecting a change in the overall profile followed by the cam follower during rotation of the cam shaft and the cam structure(s) related thereto, the cam system characterised by the change in profile effected by the positional configuration of the side cam structure effecting variable translational motion to the cam follower and effecting in turn a variation in speed of operation of a preferred movement relevant to a mechanical requirement.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the cam structure(s) comprises any one of a plate cam, a face cam, a drum cam relevant to the application with which the cam system is used.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the follower comprises any one of a knife-edge follower, a roller follower.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein either or both the central cam structure and the side cam structure take any appropriate shape as required to effect a preferred edge profile as required to effect preferred translational motion via the follower to effect operation of a mechanical requirement

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein either or both multiple central cam structures and side cam structures may be employed.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the number and arrangement of the side cam structure(s) relative to the central cam structure(s) determine desired variability in

timing/speed of the translational motion of the follower to effect variability in the mechanical operation required.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein either or both the central cam structure(s) and the side cam structure(s) are maintained in a fixed relationship to each other during operation of the cam by the configuration of either or both cam pivoting apparatus and cam locking apparatus.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein in order to interlock the cam structures, each structure includes at least one aperture capable of alignment with a complementary aperture on another structure, through which the cam locking apparatus is engaged.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the configuration of the cam locking apparatus complements the configuration of the apertures and includes any one or more of a tapered, threaded, bayonet, push fit locking pin.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein side cam structure is adjustable positionally with respect to the central cam structure.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the cam system becomes adjustable via the use of complementarily positioned apertures on the cam plates.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the positioning of the apertures on the cam plates, the distances between adjacent apertures and the ability to variably position the

side cam structure(s) with respect to the central cam structure(s) contribute to a range of configuration options.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein adjustability of the cam structures' positions relative to each other in turn effects variation in the combined cam edge profile.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the variation to the configuration of the cam edge profile in turn effects incremental variation in the translational movement of the cam follower and effect variation in the speed of operation of the mechanical function required.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein adjustability of the position of the side cam structure(s) relative to the central cam structure(s) is effected by use of at least one cam pivoting apparatus.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the cam pivoting apparatus when in place enables the side cam structure(s) to freely pivot laterally to the central cam structure(s) to whatever position is required to effect the preferred combined edge profile and thus the variation in operation of the cam system and once the desired configuration is determined, the cam structures are interlocked via the cam locking apparatus.

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the operational speed variations available between the cam system when set at its lowest setting (smallest configuration) and its highest setting (largest configuration) with two side cam plates attached is approximately 200% (two hundred percent).

According to another aspect of the present invention, there is provided a cam system substantially as described above wherein the cam structure is associated with a travelling irrigator.

In preferred embodiments of the present invention the central cam structure consists of at least one central flat cam plate. For ease of use, the cam structures shall from hereon be referred to as cam plates. However, use of this term should not be seen as limiting the scope of this invention.

In one preferred embodiment, the central cam plate has a preferred edge profile as required to effect preferred translational motion via the follower to effect operation of a mechanical requirement. For example, in relation to the use of the invention with travelling irrigators, the translational motion effects the winding in of the wire rope of the irrigator.

In other embodiments however, the cam structure may be a face cam or drum cam, with an appropriate configuration and /or profile as required.

It must also be appreciated that where plate cams are employed with the invention that multiple central cam plates may be used. Therefore, in a further preferred embodiment, at least two central cam plates are employed. The at least two central cam plates are arranged substantially parallel to each other. However, the multiple cam plates are preferably distanced from each other. The distance between the central cam plates is such as to allow attachment of at least one side cam structure.

Nevertheless, the distance between the central cam plates may be determined by any one or more of the depth dimensions of the at least one side cam structure, or by the configuration of either or both cam pivoting apparatus and cam locking apparatus used to maintain the central cam plates in a fixed relationship to each other.

For ease of use, the cam pivoting apparatus and the cam locking apparatus shall now be referred to as a cam pivot pin and a cam locking pin, respectively. However, use of these terms should not be seen as limiting the scope of this invention.

The central cam plate(s) may be configured to take any appropriate shape as required to effect the preferred edge profile required to effect the preferred translational motion via the follower.

In preferred embodiments of the present invention where the invention is described with relevance to plate cams, the side cam structure also consists of at least one flat side cam plate. The side cam plate also has a preferred edge profile that complements, but extends the edge profile of the central cam plate(s) as is required to effect a varied preferred translational motion via the follower to effect the desired variation to the mechanical operation.

In other embodiments however, where the cam structure may be a face cam or drum cam, the configuration of the side cam structures would need to be adapted to enable the side cam structure not only to be attachable to the central cam structure(s), but also to be complementary to the required profile.

It should be appreciated that the present invention lends itself to use of more than one side cam plates with one or more central cam plates. The number and arrangement of the side cam plate(s) relative to the central cam plate(s) will thus determine desired variability in timing/speed of the translational motion of the follower to effect variability in the mechanical operation required.

The side cam plates are arranged relative to the central cam plate(s) so as to create a relatively seamless extension to the edge profile of the overall combined structure. In one embodiment of the present invention this is achieved by the side cam plate being positioned in between two adjacent central cam plates. In yet other embodiments, the side cam plate(s) may be configured to have a stepped configuration in a cross-sectional side

view, such that the side plate includes an overlapping portion capable of overlapping a portion of a surface of a central cam plate and a complementary portion of the same depth as the central cam plate. Thus when the two plates are aligned the overall combined edge profile is different to the edge profile of the central or side cam plate alone, yet the configurations of the cam plates are such that the combined edge profile is substantially seamless.

The side cam plate(s) may be configured to take any appropriate shape as required to effect the preferred combined edge profile required to effect the preferred translational motion via the follower. Depending on the desired performance, one or more side plates may be attached to the central cam plate(s).

To maintain firm connection between either or both multiple central cam plates and attached side cam plates at least one cam locking pin is used to effect the plates in a fixed relationship to each other. There is preferably at least one additional locking pin for each additional plate. The locking pin is inserted to keep the cam plates in the preferred arrangement.

In order to interlock the plates, each plate includes at least one aperture capable of alignment with a complementary aperture on another plate. Thus when the locking pin is engaged with in-line apertures on two or more plates, the plates are fixed together firmly. It is important to effect firm interlocking not only given the torque effected via the central rotational cam shaft, but also as any sloppy movement of the cam plates relative to each other may negatively impact on the operation of the cam structure, as well as resulting in wear around the internal surface of the apertures which would further increase the likelihood of inter-plate movement. Further, burring or wearing of the apertures would also necessitate replacement of the cam plates more frequently.

The present invention preferably uses a tapered locking pin. The taper is set at 7° (degrees). This degree of tapering effects a very firm fit and maintains the plates in a tight relationship with each other. This is important to minimise movement of the plates

relative to each other that might affect the functionality of the cam system, or cause damage to the plates. The cam plate apertures are also preferably tapered to 7° (degrees) to accept the pin. Whilst other degrees of tapering may be preferred in some situations, any less than 7 degrees makes it extremely difficult to separate the plates after they have been locked. In order to complete the locking process, a threaded bolt is fixed to an underside surface of the cam plate(s) to complement a corresponding thread included on the tapered pin.

Whilst one form of locking pin has been described in relation to the present invention, it should be appreciated that any other suitable locking means or a combination of locking means may be employed, or adapted for use with the cam system, without deviating from the scope of the invention. Accordingly, the locking pin may be configured to include a threaded, bayonet, or push fit locking pin.

Just as the apertures in the central and side cam plates facilitate interlocking of the plates, the same or additional apertures are used to effect adjustability of the cam plates' positions relative to each other and in turn effect variation in the combined cam edge profile.

Thus in preferred embodiments of the present invention, the cam system becomes adjustable via the use of complementarily positioned apertures on the cam plates. The positioning of the apertures on the cam plates, the distances between adjacent apertures and the ability to variably position the side cam plates with respect to the central cam plate(s) contribute to a range of configuration options. The various configurations in turn are able to effect incremental variation in the translational movement of the cam follower and effect variation in the speed of operation of the mechanical function required.

Thus, the adjustable cam allows an incremental increase in the power or speed of the cam, depending on the setting chosen for the arrangement of the central cam plate(s) and the additional adjustable side plates.

In order to more easily adjust the position of the side cam plate(s) relative to the central cam plate(s) the present invention preferably includes at least one cam pivot pin. As with the cam locking pin, there is preferably one cam pivot pin for each additional side cam plate. The cam pivot pin is inserted through complementarily positioned cam pivot apertures on each cam plate. When the cam pivot apertures are aligned and the cam pivot pin is in place, the side plates are able to freely pivot laterally to the central cam plate(s) to whatever position is required to effect the preferred combined edge profile and thus the variation in operation of the cam system. Once the desired position of the one or more cam side plates is determined, the plates are all interlocked via the cam locking pin previously discussed.

The cam pivot pin is preferably retained in position via use of a cotter pin through an aperture at the base of the pivot pin. However, any other locking system that retains the pivot pin in place as required may be used with this invention.

Whilst a cam pivot pin is described with reference to the present invention, it should also be appreciated that other adjustment means may be employed or adapted for use with the invention.

The design of the present cam system is such that it enables adjustments to be made incrementally and with relative ease. Simply, the central cam plate(s) may be used alone. Alternatively, one or more side cam plates may be added to provide adjustability. Depending on what speeds are required, the cam locking pin(s) is removed, the side cam plate(s) pivoted to a preferred position equating to a preferred outcome, the cam apertures on the adjacent plates are realigned and the locking pin replaced. Such adjustment is therefore not time intensive, does not require complex additional pieces of machinery, specialist knowledge or tools and is an effective adjustment means.

The speed variations available when the different cam positions are set, may be better described as percentages for comparative purposes. The difference in operation between the cam system when set at its lowest setting (smallest configuration) with side cam

plate(s) attached and its highest setting (largest configuration) with two side cam plates attached is approximately 200% (two hundred percent).

In the embodiment particularly described in this specification the number of adjustment apertures in the side cam plates – if spaced evenly – can also be shown as a percentage. Foe example, six apertures divided by 100 equates to 16.6%. Thus each aperture setting adjustment in relation to the side cam plates effects a comparable increase in the speed by 16.6%. This effect also is relevant for equally spaced holes in the central cam plate(s).

Therefore, a combination of cam adjustment apertures in both the central cam plate(s) and in the side plates, along with whether one or two side cam plates are used, provides a greater range of cam configuration/cam positions and hence a range of variations in speed.

The combined cam plate configurations and hence settings as can be appreciated are extensive, determined by either or both the number of cam adjustment apertures and the spacing between the cam adjustment apertures.

As can be appreciated the adjustments to the cam system operation obtained through the numerous alternative positions of the side cam plates relative to the central cam plate(s) of the present invention and a range of speed options provides an advantage over prior art cam systems used particularly with travelling irrigators, as well as in other machinery which could benefit from the incorporation of an adjustable cam system.

As mentioned previously, the cam has been designed for use on a travelling irrigator as used on dairy farms, for example. Such irrigators typically have a fixed (non-adjustable) cam. The travelling irrigators are commonly used on farms for transferring the substantially liquid wastes from a dairy (milking) shed over neighbouring paddocks in a manner that directly returns raw nutrients to the land. In other applications, any suitably fluid substance may be sprayed, or aerated, as required for the particular situation.

The cam associated with a travelling irrigator is typically in the form of a plate cam. In such machinery the cam system provides power during revolution of the cam plate as the irrigation boom revolves. The rotational movement of the cam plate is translated through the follower to effect the winding in of the wire rope of the irrigator. In such applications the cam plate is fixed to a preferable size and shape. Such fixed structural features operate against the cam dimensions being adjustable and thus limit adjustability of the translational motion effected through the follower and hence restricts any variability of the speed of the preferred operation.

However, having a simple variable speed cam system for use with travelling irrigators would benefit the operation of the irrigation process by allowing for either a speeding up of the operation or slowing it down, depending on the size of the area being irrigated and/or the quantity of fluid being delivered by the irrigator. However, at times it is useful to have the standard cam plate to effect the standard operation of the machine.

As can be appreciated variations to and from the above described embodiments may be made without deviating from the scope of the present invention.

It should further be appreciated a variety of different embodiments, uses, and applications of the present invention exist, even within the ambit of the above described cam system. A specific embodiment for the present invention will now be given by way of example only, to help better describe and define the present invention. However, describing one embodiment should not be seen as limiting the scope of this invention.

Brief Description of Drawings

Further aspects of the present invention will become apparent from the following description, given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a perspective view of the adjustable cam system in accordance with one preferred embodiment of the present invention; and

Figure 2 is a cross-sectional view of the adjustable cam system of Figure 1 in accordance with one preferred embodiment of the present invention; and

Figure 3 is a top plan view of the adjustable cam system of Figures 1 and 2 showing available adjustment positions, in accordance with one preferred embodiment of the present invention; and

Figure 4 is a top plan view of the adjustable cam system of Figures 1 and 2 showing further available adjustment positions to those of Figure 3, in accordance with one preferred embodiment of the present invention.

Best Modes for carrying out the Invention

With reference to the diagrams (Figures 1 to 4) by way of example only, there is provided a cam system (generally indicated by arrow (1)). Whilst the cam system is described and referenced for use with travelling irrigators, it should be appreciated this invention may have application outside of this field.

The cam system includes at least two cam structures (illustrated in Figures 1-4), a cam follower (not shown) capable of following a preferred profile effected by the configuration of at least one of the cam structures, and a substantially central cam shaft (also not shown).

The cam structures are adapted at (8) to have a circumferential edge profile along which the follower travels. The central cam plate(s) may be configured to take any appropriate shape as required to effect the preferred edge profile required to effect the preferred translational motion via the follower.

The cam structures comprises at least one central cam structure (2) and at least one side cam structure(3) and (3a). The central cam structure is adapted at (9) to receive the cam shaft. The central cam plate(s) may be configured to take any appropriate shape as

required to effect the preferred edge profile required to effect the preferred translational motion via the follower. The central cam structure(s) or central cam plate(s) (2) are further adapted to receive at least one of the side cam structure(s) or plate(s) (3) and (3a).

The central cam structure illustrated in Figures 1 and 2 particularly, consists of two substantially flat central cam plates arranged substantially parallel to each other, but distanced from each other. The distance between the central cam plates is such as to allow attachment of at least one side cam plate.

The distance between the central cam plates may be determined by any one or more of the depth dimensions of the side cam plate, or by the configuration of either or both a cam pivot pin (4) and a cam locking pin (7) used to maintain the central cam plates alone, or in conjunction with the side plates, in a fixed relationship to each other. There is preferably at least one additional locking pin for each additional plate.

In order to interlock the plates, each central plate includes at least one aperture (6) capable of alignment with a complementary aperture (6a) on the side cam plate(s). Thus when the locking pin is engaged with in-line apertures on two or more plates, the plates are fixed together firmly.

The position of the side cam plates can however be varied with respect to the central cam plate to effect a change in the profile of the central cam plate when viewed alone, and in turn change the overall profile followed by the cam follower during rotation of the cam shaft and the cam plates(s) related thereto.

The side cam plates are arranged relative to the central cam plate(s) so as to create a relatively seamless extension to the edge profile of the overall combined structure. In one embodiment of the present invention this is achieved by the side cam plate being positioned in between two adjacent central cam plates as shown in the attached figures. In yet other embodiments (not shown), the side cam plate(s) may be configured to have a stepped configuration in a cross-sectional side view, such that the side plate includes an

overlapping portion capable of overlapping a portion of a surface of a central cam plate and a complementary portion of the same depth as the central cam plate. Thus when the two plates are aligned the overall combined edge profile is different to the edge profile of the central or side cam plate alone, yet the configurations of the cam plates are such that the combined edge profile is substantially seamless.

Depending on the desired performance, one or more side plates may be attached to the central cam plate(s). Just as the apertures in the central and side cam plates facilitate interlocking of the plates, the same or additional apertures are used to effect adjustability of the cam plates' positions relative to each other and in turn effect variation in the combined cam edge profile.

The various configurations are illustrated particularly in Figures 3 and 4 to show how incremental variation in the size of the cam plate system can be achieved. Thus, the adjustable cam allows an incremental increase in the power or speed of the cam, depending on the setting chosen for the arrangement of the central cam plate(s) and the additional adjustable side plates.

To adjust the position of the side cam plate(s) relative to the central cam plate(s) at least one cam pivot pin (4) is used. As with the cam locking pin, there is preferably one cam pivot pin for each additional side cam plate. The cam pivot pin is inserted through complementarily positioned cam pivot apertures (5) on each cam plate. When the cam pivot apertures are aligned and the cam pivot pin is in place, the side plates are able to freely pivot laterally to the central cam plate(s) to whatever position is required to effect the preferred combined edge profile and thus the variation in operation of the cam system. Once the desired position of the one or more cam side plates is determined, the plates are all interlocked via the cam locking pin (7). Simply, the central cam plate(s) may be used alone, or one or more side cam plates may be added to provide adjustability.

As can be appreciated variations to and from the above described embodiments may be made without deviating from the scope of the present invention.

It should also be understood that the term "comprise" where used herein is not to be considered to be used in a limiting sense. Accordingly, 'comprise' does not represent nor define an exclusive set of items, but includes the possibility of other components and items being added to the list.

This specification is also based on the understanding of the inventor regarding the prior art. The prior art description should not be regarded as being an authoritative disclosure of the true state of the prior art but rather as referring to considerations in and brought to the mind and attention of the inventor when developing this invention.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

PETER JOHN KENNETH REID

By his attorneys

Janice Tyrer-Harding

PIPERS CENTRAL

Figure 1

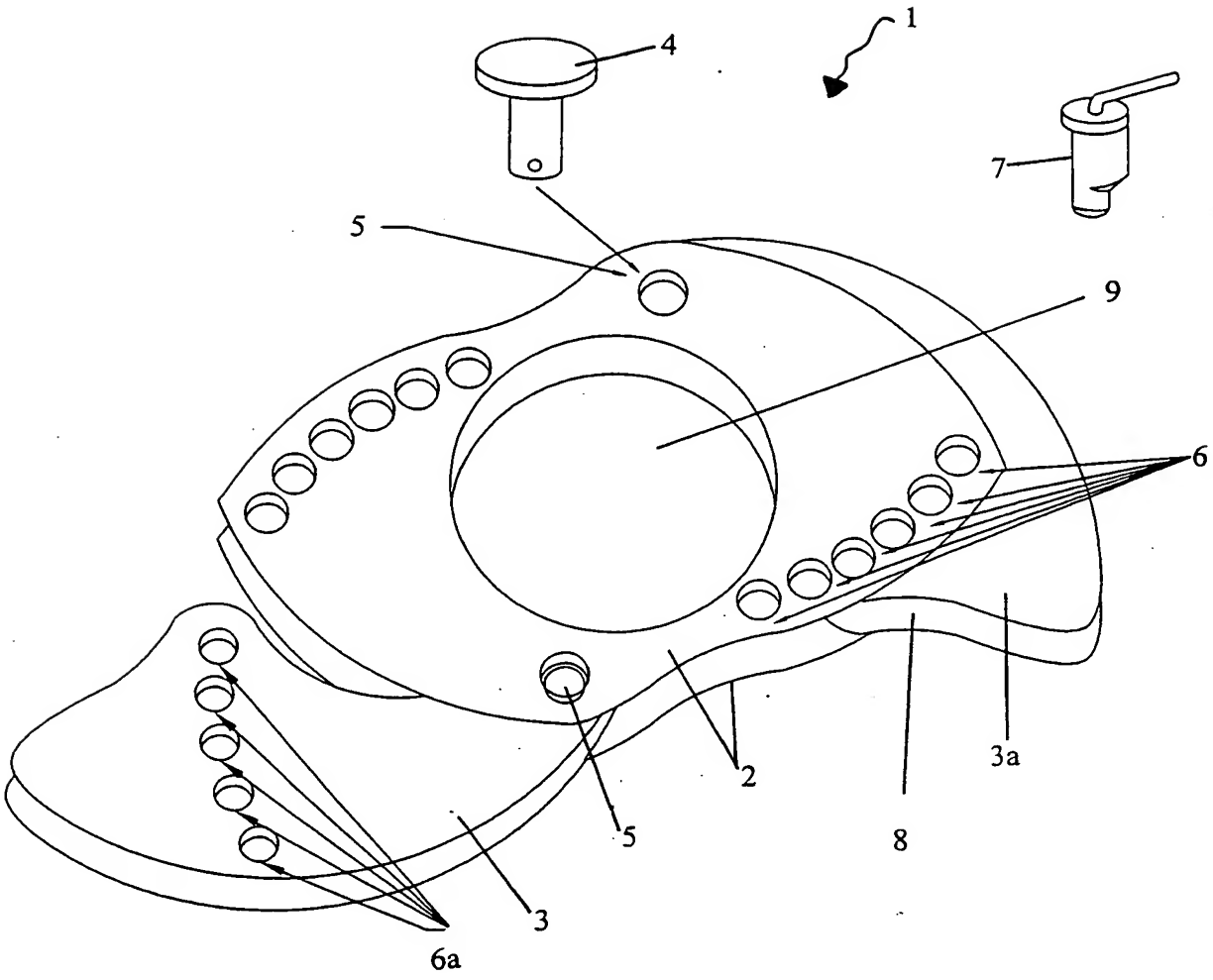

Figure 2

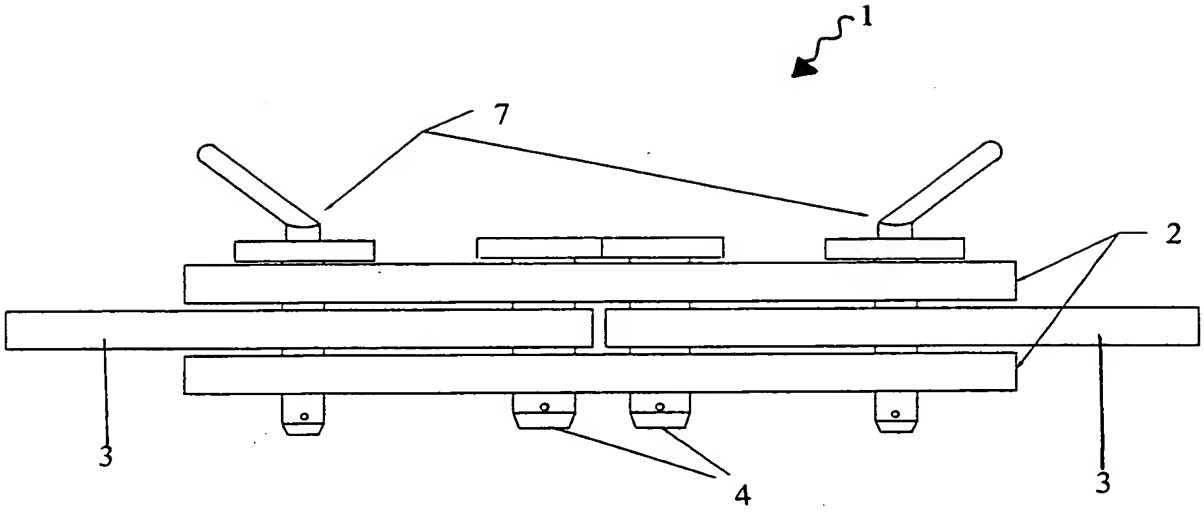

Figure 3

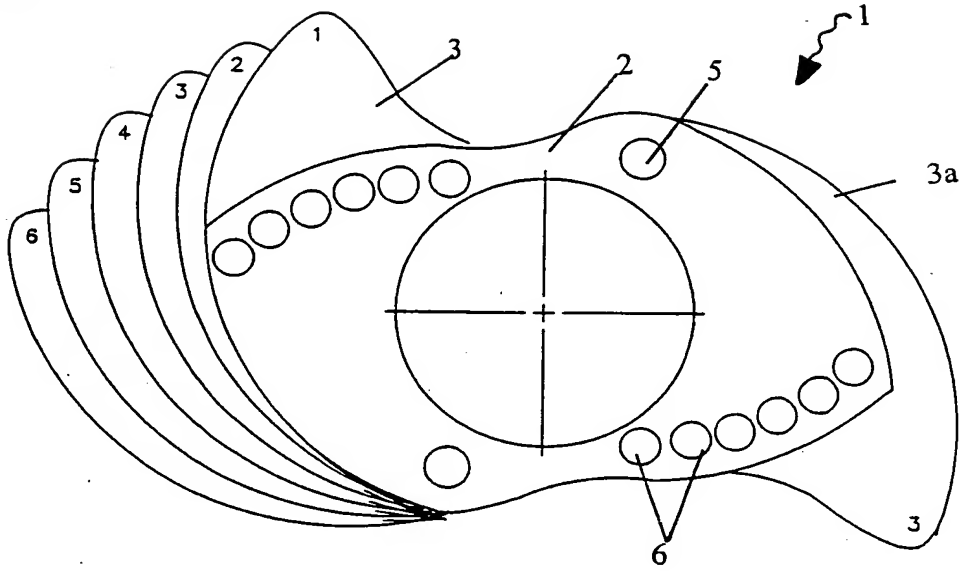

Figure 4